ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY

INTERVIEWS WITH

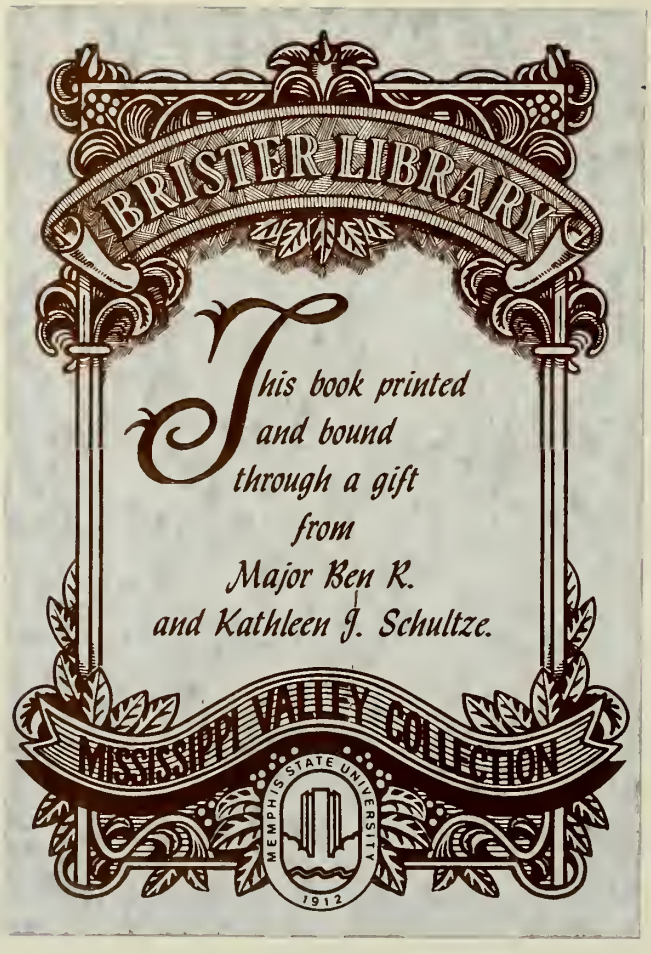
HOWARD P. EMERSON

BY - CHARLES W. CRAWFORD

TRANSCRIBER - SHARON C. HESSE

ORAL HISTORY RESEARCH OFFICE

MEMPHIS STATE UNIVERSITY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JUNE 3, 1972

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PLACE Knoxville, Tenn.

DATE June 3, 1972

Howard P. Emerson

(Interviewee) Howard P. Emerson

Charles W. Crawford

(For the Mississippi Valley Archives
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THIS IS THE ORAL HISTORY RESEARCH OFFICE OF MEMPHIS STATE UNIVERSITY. THIS PROJECT IS "AN ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY." THE PLACE IS KNOXVILLE, TENNESSEE. THE DATE IS JUNE 3, 1972, AND THE INTERVIEW IS WITH MR. HOWARD P. EMERSON, UNIVERSITY OF TENNESSEE, RECENTLY RETIRED. THE INTERVIEW IS BY DR. CHARLES W. CRAWFORD, DIRECTOR OF THE MEMPHIS STATE UNIVERSITY ORAL HISTORY RESEARCH OFFICE, AND WAS TRANSCRIBED BY MRS. SHARON C. HESSE.

CRAWFORD: Mr. Emerson, I suggest we start by getting some background information about you. You might start with something about your early life and your experience to the point at which you did join TVA. Then we'll get into your experiences with the Tennessee Valley Authority.

EMERSON: I grew up in New England, as my voice may indicate, graduated from Dartmouth College in 1923 with a major in chemistry. Then I taught for three years at Robert College in Turkey on the Bosporus. I taught general science in the academy, chemistry, lectures and lab in the college, and physics laboratory in the college. We also had there an engineering college. Then I came back and got a degree in electrochemical engineering at the Massachusetts Institute of Technology in 1928. I worked for awhile with Western Electric and then received an offer from the DuPont Ammonia Corporation, which put up one of the first two commercial plants to make synthetic ammonia in

the United States.

This experience with the DuPont Ammonia Corporation led to an interest later when the depression came to find out more about the Tennessee Valley Authority which was given responsibility for building up the land resources, as well as the water resources, of the Tennessee Valley. The TVA had inherited a nitrogen plant. Synthetic ammonia, of course, is one way to get nitrogen out of the air, and TVA had inherited from World War I a plant to make nitrogen by the calcium cyanamide process at Muscle Shoals.

This accounted for my interest in TVA which I joined in May 1933, one month after it started. I had applied and filed an application with Arthur E. Morgan at Yellow Spring, Antioch College. This application showed up months later after I had been employed. In order to expedite things I went to Dr. Morgan's temporary office, which was his bedroom in the Willard Hotel in Washington. He and Carl Bach used the bed to spread out their reports and they used their rooms there as the Washington office of the Tennessee Valley Authority. I left my application; it was later approved, and I joined the TVA first in Washington and came to Knoxville in January 1 or 2 of 1934, and was with the Tennessee Valley Authority until 1948 when I joined the University of Tennessee as head of the Department of Industrial Engineering.

The early decisions of the Board of Directors of TVA had much to do with the future of the organization. For

example from the point of view of organization, at the beginning Dr. Arthur Morgan supervised the activities in the fields of civil engineering and dam construction. That was his specialty. Mr. Lilienthal, with his background in the control of electrical power companies in Wisconsin, more or less kept a close finger on the developments in the power program of TVA. And Dr. Harcourt Morgan, who came to the Authority from the presidency of the University of Tennessee and before that as Dean of Agriculture, supervised the agricultural program. One of the first important decisions in TVA was to take away from the Board of Directors these supervisory activities and convert them into a real Board of Directors with a General Manager or Coordinator presenting to the board the matters for their joint decision, and this organization change was very important in the early days of TVA.

Another important decision was made at the recommendation of Dr. Harcourt Morgan. He felt that if TVA went out of business, any activities in the field of agriculture should be started working closely with the agricultural colleges of the seven Tennessee Valley states so that they could carry on if TVA stopped their activities, or in any case, a joint program could be developed. This was an important decision keeping the agriculture program at the grassroots level where, of course, it belonged; and yet it involved getting the cooperation of the agricultural colleges, their agricultural experiment stations, their agricultural extension services, and their

teaching staffs in seven different valley states. And a major decision was referred to them by Dr. Morgan, a proposal to convert the nitrogen plant available for making calcium cyanamide converting nitrogen from the air at Muscle Shoals--an important plant food fertilizing material. Mr. Morgan recommended this be converted to electric furnaces to make phosphorus.

Back of this reasoning was the specter of the depression. Dr. Morgan felt that farmers could grow their own nitrogen through crops like lespedeza or soybeans or clovers, which through the nodules and the roots of the plants can take nitrogen out of the air. Farmers could rotate such crops and fix nitrogen from the air in the soil and then grow other crops to utilize this nitrogen.

They could not do this with phosphorus. Phosphorus comes out from deposits in certain specific places in the country. One of these was middle Tennessee; another is Florida and another in the Rocky Mountains. The phosphate rock has to be mined and the usual procedure was then to treat it with sulphuric acid to make a phosphate fertilizer which farmers could then buy and put on the soil. Dr. Morgan felt that TVA's best contribution could be to cheapen the cost of this phosphorous fertilizer which farmers had to purchase and let them, at the beginning anyway, raise their own nitrogen through these special crops. Later on, of course, with the Second World War, TVA got into making both nitrogen and phosphorus at its plant at Muscle Shoals. These two ingredients are available and useful in war and in peace.

This leads us into a discussion of Dr. Morgan's concepts about man's relation to nature, about the TVA responsibility for developing the physical resources of the Tennessee Valley. Dr. Morgan's philosophy influenced other directors and department heads in TVA and in the early days set the stage for many practical aspects of the program. For example, this decision to convert the electric furnaces at Muscle Shoals into treating phosphate rock rather than making a nitrogen fertilizer. To understand that decision and others, the concepts of Dr. Morgan are important. He called these a "common mooring," feeling that they were fundamental concepts of nature and man's obligation in relation to it which everybody in the world should have. His idea was to pick the fundamental, comprehensive aspects of knowledge that were essential to every person, and he explained these to many groups, especially the agricultural groups who worked closely with the contributions of nature.

The best way to tell this story would be around the problem of building up the food resources of the Tennessee Valley or of any other region. And Dr. Morgan as a biologist and later as Dean of Agriculture, had an unusual background for conceiving of this concept and presenting it to the people in the Tennessee Valley. The best way to jump into this concept is in connection with the problem of food. And if Dr. Morgan were explaining it, he would pick up some chalk, move to the blackboard, and probably first list the plant compounds that are

essential to all foods; and those listening might wish to write these down. They are as follows: starch, sugar, fats and oils, cellulose, and protein--plant compounds essential to all foods. Many in nutrition and concerned with food go little beyond this other than to think about the sugar cane and the stalks of corn that provide these materials, but Dr. Morgan's mind always tried to get to the fundamentals of any problem. For example, if you've written down this list, opposite the word sugar how about putting down the list of the chemical elements of which sugar is made. If you remember your chemistry, ordinary sugar contains six atoms of carbon, twenty-two atoms of hydrogen, and eleven atoms of oxygen, $C_6H_{22}O_{11}$. In any case, it's made of three elements only: carbon, hydrogen, and oxygen. On your list you could put the same elements opposite starch, the same elements opposite the vegetable oils and fats, the same elements are found in cellulose.

And with cellulose we are now covering not only a food compound, but the basis for shelter and clothing, for out of cellulose the wood of trees can come the house in which we live if it is made of wood. Many chemical products are made from cellulose. Right here in the Tennessee Valley, the Tennessee Eastman Corporation used to convert by distillation some of the hard woods into acetic acid; they now make this directly synthetically. They also make cellulose acetate and convert it into fibers for clothing and to plastics for many manufactured products. This was about to be called the age of cellulose before it became the atomic age. And cellulose, again, like fats and

sugars and starch, contains only three chemical elements: carbon, hydrogen, and oxygen. When we come to protein, we have to add one element--nitrogen.

Now, again following Dr. Morgan's thinking, let's trace these elements back to the sources from which they came, and in his common moorning, nature was like a seamless web. Or from another point of view, it was like a series of cycles: the natural cycle, the hydrologic cycle, the nitrogen cycle, the growth cycle. Let's trace back these three elements or four elements to the sources from which they come to see whether we have adequate basis for feeding the people in the Tennessee Valley or any other region. Well, the element of carbon comes from the carbon dioxide of the air. The hydrogen comes from water--H_2O--and the oxygen is available from water or from the air. One-fifth of the air is oxygen. Growing plants convert these elements from air and water into these plant compounds with the help of energy, the heat of the sun, and the chlorophyll as a catalyst available in the green leaf of the plant, or the tree in the case of cellulose, and this synthesis goes on quietly all around us. The cellulose can be used as food, as the basis for clothing or synthetic plastic products; but it also, in the form of wood, can be used as a fuel. And this same cycle and same chemical process which converts the elements of air and water into plant compounds can be--did, in fact, millions of years ago--convert these things into sugars and fats and cellulose, and then with the action of time the hydrogen and the

oxygen came off and we had left coal, for example. When the oxygen itself separated by the action of other elements, we had carbohydrates in the form of oil and gas, and so we find a natural cycle that not only provides the raw materials for food and industry, but the energy to operate the industry or the processing that is needed. The conversion of these elements into wood takes place quietly in our forests.

The study made at TVA in the early days, at my suggestion, showed that there were more BTUs or calories or kilowatt hours converted from air and water into wood for fuel than from all of the TVA dams which were operating at that time. All of the man-made TVA dams--two or three at that time--did not produce as many kilowatt hours of electricity for heat, for light, as nature was producing quietly in the forests of the Tennessee Valley and which were then actually being used for heating homes, for running sawmills, and other energy conversion purposes. This story is no longer true. The farmers no longer burn wood in their homes; they convert the water into electricity and use the electricity, but in the early days the natural cycle was producing a major source of the energy used in the rural areas of the Tennessee Valley.

Now with the consideration of protein--carbon, hydrogen, oxygen, and nitrogen--we're back at the problem of production of nitrogen from the air. Is there enough nitrogen to provide food for our growing populations? Well, Dr. Morgan figured out that there were 20,000,000 tons of nitrogen over every square mile of the earth's surface. From

his point of view the creator of the world in which we live has done his share in providing the basic elements needed for food. If anybody is starving in the world, it is man's problem. Nature has done its share in providing the basic materials for the solution of the problem of food. And yet this probelm of food is still with us in spite of Dr. Morgan's attempts to teach us that the food problem is not entirely one of the basic sources of the materials for food. The carbon, hydrogen, oxygen, and the nitrogen are available in plentiful quantity in air and water.

But people from India will say, and have said, that water is a precious resource; it isn't inexhaustible. And even in the Tennessee Valley, where fifty-two inches of water fall in the mountains and an average of forty or fifty inches is available over the whole valley, even here we have droughts and rivers that dry up in the summer. The Tennessee River itself could be crossed with horse and wagon on some dry months of the year before the TVA dams. So if water is needed to build up this natural cycle as a perpetual source of food, it can be made available day after day, month after month by a series of dams such as were built on the Tennessee River and its tributaries, the most completely controlled waterway in the world. So if we are dealing with the problem of food, the water availability has been provided. The early concept of farmers growing lespedza and soybeans and so forth to take nitrogen out of the air and add it to the soil was a little too slow for the agriculture

production so that TVA, as I mentioned, also went into the manufacture of nitrogen in terms of synthetic ammonia, taking the nitrogen out of the air and the hydrogen out of the Tennessee River, converting it synthetically into ammonia and then into ammonium nitrate or other forms of nitrogen fertilizer, so now TVA makes both nitrogen and phosphorus.

But let's turn to phosphorus. This story has been simplified, perhaps oversimplified, in the sense that it would appear that we have no material problem in connection with food. Now it is true that 95 percent of the plant compounds do come from carbon, hydrogen, oxygen, and nitrogen; but in wheat, for example, in the grain of the wheat, 1.4 percent comes from phosphorus or calcium. And as a rough figure, unless the plant can grow in soil, the stalk of the plant and the kernel of the grain or the product requires some phosphorus and calcium and potassium and magnesium and sulphur--minerals that are in the soil but with overcropping can be taken out and the soil no longer able to grow the crops that are going to provide the starches, sugars, fats, cellulose, and protein. But only five percent or less of these minerals are required, but one of these is phosphorus.

Phosphorus is in every bone and blood cell. Of all the ninety-two elements, Dr. Morgan felt that phosphorus was the most important. Due, however, to our educational system of compartmentalized instruction, nobody really learned the whole story about phosphorus. The people in home ec. studied it as an element needed in nutrition; the physiologists found that it was

needed in bones and muscles and blood; the agricultural people knew that they had to put phosphorus back on the soil if the soil was overcropped or if the topsoil washed away, and they did it by first putting the phosphate rock in which the phosphorus is found, directly on the soil. In the state of Illinois they kept up that system although it was very inefficient.

In most parts of the country and in Tennessee they combine the phosphate rock with sulphuric acid. Sulphuric acid from Coffee Hill, Tennessee, combined with phosphate rock from Middle Tennessee, would make what they called a superphosphate. Dr. Morgan pointed out that the phosphate rock contained 32 percent phosphorous oxide, and the superphosphate contained only 18 percent, but until TVA, that was the only way to get the phosphorus back to the soil. Phosphate rock contains phosphorus very slowly available to plants. The superphosphate is almost immediately available.

And that was why Dr. Morgan in the early days of TVA had the Board of Directors make the decision, after recommendation from the seven agricultural colleges, to convert the calcium cyanamide furnaces at Muscle Shoals into treating phosphate rock and sand and coke in the electric furnace to produce elemental phosphorus which then could be converted into fertilizer materials. The farmer, in turn, was taught to put this back on the soil in greatly increased quantities. In the past fertilizer had been added in driblets, and little result appeared.

The agricultural people of the seven valley states and TVA were able to show the farmer that by using greatly increased quantities of phosphorus and limestone for the calcium and irrigation, if it was needed, to provide the water, they could double or treble the production of crops.

The University of Tennessee has a project in India where they've shown the people in southern India how to double production of certain grains--double, treble, quadruple--by methods that grew out of these concepts of Dr. Harcourt Morgan. Dr. Morgan did more for agriculture and the production of food, not only in the Tennessee Valley but throughout the world, than any other individual. His concepts of the natural cycle were not well accepted by men over-educated in compartmentalized subjects, but as one retired member of the agricultural department of TVA told me, the intellectuals--the Ph.D.s, the statesmen who had come to talk to Dr. Morgan--may not understand this: the congressmen to whom he makes an appeal for fundamental efforts to build up the land and the forests of the valley may not understand what is back of his plea for congressional help, but the farmers of the valley understood Dr. Morgan. He talked their language. They understood that if they took elements from the soil, they had to put them back.

They understood something further. In connection with phosphorus, I attended for many years the Morgan Sunday School class at the Church Street Methodist Church in Knoxville, Tennessee. No matter what the Sunday School lesson was or the text from the Bible, Dr. Morgan came around to talk about

phosphorous. No other Sunday School teacher had probably ever brought prosphorus into his Sunday School lesson. If there was a religious motivation to feed people and do it more than in an annual Thanksgiving basket or once a year in one great hour of sharing, that obligation could only be met with knowledge from a scientist. He knew the technology of industry, agriculture and engineering to make this phosphorus available as the basis for a perpetual source of food for a growing population.

But more than that, a motivation was needed, and Dr. Morgan found it in a theology that was not comprehended by the ministers and theologicans. But it did involve the concept that creation did not just happen; that it didn't just happen that man was put on the earth to expand in population and control the resources of the earth, without at the same time there being made available the basic elements from which man would need to grow his own food, for example. Dr. Morgan's concept was that a creator of man would create the materials he needed to live, and from this analysis of Dr. Morgan's common mooring, we see that has actually been the case; that these four chemical elements come from air and water, of which there is an inexhaustible supply, if through knowledge and science we will but put back the elements that are exhaustible--the phosphorus and the calcium and the potassium--that are removed in the growing of these crops.

Dr. Morgan proposed a slogan that ecologists throughout the world might well follow. His slogan was this: "Accelerate

the use of the inexhaustible and conserve through intelligent utilization the exhaustible." Accelerate the use of elements from air and water to produce food for the starving populations of the world, but conserve through intelligent utilization exhaustible elements like phosphorus and calcium and potassium so that this production of food could continue perpetually.

In the early days of TVA, analysis showed that more phosphorus was being removed from the soil by erosion and cropping than was being put back; in fact, a very small proportion was being put back. A congressional committee, under the chairmanship of Senator Pope, met in Knoxville to discuss this problem. The owners of lands in Florida and Tennessee containing phosphate rock presented evidence as to the amounts of these resources. TVA presented some of their results of research in converting phosphate rock into not only 18 percent superphosphate but triple superphosphate, calcium metaphosphate--new products available to the farmer in concentrated form to get this phosphorus back to the soil. As a result of this conference, as a result of Dr. Morgan's concepts, as a result of TVA activity and the activities of the seven extension services in passing along the results of research to the farmers, in the Tennessee Valley the trend to loss of soil, loss of phosphorus to a land of depleting resources--which like other parts of the world would gradually be able to support fewer and fewer people--this picture has been completely changed; and now in the Tennessee Valley food is grown not only to support the people of the valley, but to export. This can be done perpetually as long as phosphorus

and calcium are added in small quantities to the soil. The farmers have learned to be able to continue the production of food without loss by erosion or cropping. They are passing on to the next generation the land in the same productivity as when they received it. This was not the case before.

This is one of the most important of the contributions of the Tennessee Valley Authority, and it all grew out of Dr. Harcourt Morgan's concept of a common mooring or a natural cycle based on knowledge of science, the application of technology, but particularly on motivation. The farmers in the valley began to feel that an eroded hillside was as much a sin as failure to follow the ten commandments. Many of them have expressed themselves in that way. This grew out of Dr. Morgan's approach to a concept of the world in which religion and science were all one. In his home, the Bible and the magazine Science were both on the same table. In recognition of this concept, those who understood Dr. Morgan contributed from all over the state of Tennessee and the Tennessee Valley to a stained glass window in the Church Street Methodist Church which is unique of any stained glass window in the old country or the new world in that in one panel is a scientist's microscope; in another is the Bible. Dr. Morgan was unique in that science and religion to him were all one, all part of a seamless web, and that man had an innate obligation or a God-given obligation to use the knowledge of science and technology to feed the world, to clothe the world, to convert the materials and forces of nature into products usable to man.

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EMERSON: Dr. Harcourt Morgan was the first practical ecologist. The Tennessee Valley Authority was the first organization to bring together specialists in many fields and give thorough consideration to all of the problems involved in any new engineering proposal. For example, if a lock or dam or dike was to impede the flow of water, conferences would be called with experts from the different fields or departments of the Tennessee Valley Authority. Very few of the personnel in TVA had the comprehending concepts of Dr. Harcourt Morgan. It became necessary instead to bring together the specialists in the different fields so that if a reservoir area was to be used for industrial development the problems of effluent in relation to the fish life were discussed with a fisheries expert from the nurseries or the fishery centers in TVA where fish life was being promoted. The effects on forests of a great expansion of newsprint or paper manufacturing were given consideration with experts from the forestry division of TVA, which from the

very first began to grow seedlings for replanting in the Tennessee Valley. The Industry Department of TVA furnished experts who could discuss the industrial processes involved, the raw materials that would be needed, the electric power consumption, the possibilities of using the river to bring in or ship out products, the effects on the types of effluent that would be put into the streams, All of these matters were considered by committees in TVA from the very earliest days.

TVA developed another administrative device or administrative concept that has worked well. It can be best illustrated by the problem of cooperation among the agricultural engineers in the seven valley states. It emphasized TVA's importance by just being in the area. It emphasized TVA's leadership through coordination. I was present at a meeting of the seven agricultural engineering heads from the seven valley states in a TVA office. The TVA ag-engineering department was represented, and the head of the department went to the blackboard. He suggested that let's list all of the ag-engineering problems that face the Tennessee Valley states and that we plan to do research on. For example, in the Tennessee Valley we have learned through adding nitrogen and phosphorus to the soil and even irrigation to grow more hay and forage crops for livestock economy, but in this area of high rainfall these crops are often ruined by sudden rains. Experiments should be done in using electricity, for example, through heating or fans to dry the hay so that it could be put into the barns in a

green form. With the availability of low cost electricity on the farms, the possibility of many uses for electricity in pumping and in conveyors became a possibility. Use of electric lighting to get more eggs from poultry was another project. Now normally each of these ag-engineering departments would have set up projects in all three of these areas, for example. In fact, each one would have done a duplicating work spending taxpayers' money.

After listing all of these projects that needed to be done, the head of the ag-engineering department of TVA then suggested, "Let's now vote on which are most important." And number one, for example, might be hay drying; number two, the use of lighting in the poultry area. They voted as to which were more important. Then they voted again, and each one proposed which of the projects they would like to undertake. The University of Tennessee, for example, picked hay drying; and for many years experiments were done using electricity using heat from gasoline engines, using just ordinary fans blowing air through hay. New types of barns were developed to put in hay greens so that the ventilation could be more easily undertaken. When this hay drying work came to a conclusion the University of Tennessee published an agricultural bulletin.

Now, in the past there would have been seven different bulletins describing seven different expensive research projects. Under the new system TVA made available the text of this study to all of the seven states, and seven bulletins

did result with different covers, but the same content. And inside the cover was a statement, "This bulletin on the drying of hay is based on research done at the University of Tennessee and made available through a joint program through TVA of the Agricultural Engineering Departments of the seven valley states." In turn, Tennessee had six other bulletins available from the other six agri-engineering departments--a saving to the taxpayer, a joint enterprise that saved taxpayers money.

Now these developments, like most of those in TVA, were not confined to the seven valley states. The hay drying, for example, was copied all over the United States. A relative of mine in New England put hay drying ventilating fans in his barn using the University of Tennessee procedure. His only trouble was he forgot to turn on the fan, and the green hay caught fire and burned the whole barn down. But it was development that came out of the University of Tennessee under this joint agriculture engineering program and made available to farmers throughout the United States and the world.

In the case of forest resources and the production of cellulose, in the early days of TVA both soft and hard woods were being cut faster than they grew. Through the efforts of the TVA forestry group and the nurseries growing seedlings, through the efforts of public-spirited organizations in the towns and cities helping farmers to rent or borrow machines for planting trees, through all of this effort plus the practice of private companies moving into the Tennessee Valley with paper plants

and wood-using plants to replace trees that were cut, the situation has been completely changed so that in the Tennessee Valley now a perpetual source of cellulose and of wood, both hard and soft woods, can be counted upon; and employment in that industry can be considered a perpetual possibility year after year. But the obligation to replace trees, whether divine in origin or whether the obligation is one of civic pride or the feeling that one should pass on to the next generation the resources that we have inherited, in any case a new approach seems to be at hand.

The situation illustrated by the Tennessee Copper Basin, where private industry completely destroyed the vegetation and allowed the topsoil to be washed bare over some eleven square miles near Copperhill, Tennessee, is no longer with us. The copper industry had started by using the trees to smelt the copper ore, separating the copper from the sulphur. They had allowed the sulphur to oxidize and spread sulphurous oxides to kill further the vegetation and pollute the streams and affect even the water wheels or the generator blades in the dams on the streams below the Copperhill area.

No church preached any divine obligation to conserve resources, but the states of Tennessee and North Carolina passed laws requiring that the sulphur be removed from the effluent air in the smelters. The private copper companies did this and found that they could make as much money from the sulphur compounds that they recovered, as from the copper. Later they

found that the copper ore had been depleted to such an extent that they could still afford to mine it, but only by making the recovery of all the by-products and the development of copper chemicals a multiple source of profitable products from this area. Efforts by the company and the state to rebuild this land have gone ahead very slowly.

Apparently man has the freedom, at least in Dr. Morgan's thinking, to create or destroy. Here were eleven square miles of the earth's surface practically destroyed by man's use of technology. The phosphorus and the nitrogen manufactured at TVA's Muscle Shoals plants are used in war to kill, but in peacetime to provide food for people. Man seems to have the freedom to use his discoveries and his science and technology and management skills to create or to destroy. Thus, a theology of the earth, or a theology of man's relation to his environment, or man's relation to the natural resources around him, starting with an obligation to find out about them through science, and then a motivation to put them to use for the benefit of man and of future generations needs to be developed. Such a theology is not now taught in theological school or from any pulpit. Dr. Morgan attempted in his Sunday School lessons to develop such a theology, and his thinking along these lines is available in the Harcourt Morgan collection in a special resources collection of the University of Tennessee.

The whole scope of creation, which in biblical and theological literature seems to deal with the creation of man and his relation to God, neglects the infinitely greater creation

of matter and energy which is our physical universe. Man's innate curosity to explore this universe, to make trips to the moon, to find out the laws that govern physical science, need to be part of such a new theology.

In the case of TVA, an unusual opportunity existed of bringing together specialists from many different fields trained in a compartmental type of education. Dr. Morgan as an educator, formerly president of the University of Tennessee, was greatly concerned about the difficulty of explaining subject matter that cut across the boundaries of traditional, academic disciplines. He, in fact, wrote a paper on the compartmentalization of knowledge. In his mind nature was not compartmentalized. Nature was a seamless web. Touching one part of the web affected other parts. There was an interdependence, an interrelationship, and he looked forward some day to the development of the type of educator who could see the whole forest, not just the trees, whose mind could encompass more than a narrow subject field. Dr. Morgan himself was such an individual.

An example of what a regional agency like TVA could do in the fundamental development of resources and the place of the entrepreneur or businessman, as well as the farmer, in a mutual relationship is well illustrated by the actions or activities of individuals in Decatur, Alabama. In the early days of TVA leaders in Decatur asked Mr. Lilienthal to appear and speak to them, and in the conference wanted to know what TVA was going to do for Decatur. Mr. Lilienthal took occasion to explain the TVA philosophy that whereas the Tennessee Valley Authority could

help in making available certain basic natural advantages, it would be up to the local citizens to put these to use. The TVA under its Act could provide nine feet of water in a navigable channel. It could provide dams to make a low cost electricity available to rural areas and to towns and industries. Through its agricultural program it could do research on ways to make phosphorus available in more concentrated forms and ways and means to use phosphorus and nitrogen and calcium as fertilizers in a new program of building up land for a perpetual source of food and raw materials for industry; that TVA could go further and conduct research and provide facts about the region; but the actual use of the water and the power and the plant foods and the know-how and results of research would be up to the local citizens.

With this in mind, the leaders in Decatur set up some very far-reaching programs. They got some companies to move to the waterfront area near Decatur. One was a flour mill bringing grain from Minneapolis. Another was a barge line terminal which originally brought grain for the cattle of northern Alabama. Later on, with the help of the TVA agricultural department, and the Alabama Extension Division and Experiment Station, a livestock program was set up in northern Alabama, and as part of this program the grain for the livestock was grown right there, replacing some of the one-crop cotton system and producing a more profitable product for the farmers to work with. The businessmen in Decatur helped the farmers breed better stock,

feeling that the prosperity of the surrounding rural area would help the prosperity of the central trading center or city on which the rural area depended. Sites for industry were developed along the river, which now is completely studded with important industries; one producing raw materials for another in a network of interrelated factories which have brought prosperity to Decatur. Recreational areas were built up to make the area more interesting to prospective industries--water skiing on the river, boating, bathing--all of the resources that TVA had suddenly made available were put to use. The land in that area has been built up as a perpetual source of food and raw materials for industry. Forest industries have been promoted. An entirely new way of life based on the fullest development of the physical resources of the region under the guidance and coordination of TVA and the state agricultural and industrial organizations has resulted.